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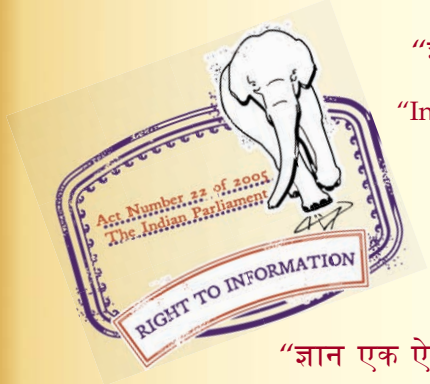
IS 11125 (1984): General requirements for plate heat exchangers for marine use [TED 19: Marine Engineering and Safety Aids]



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IS : 11125 - 1984
(Reaffirmed 2005)

Indian Standard

GENERAL REQUIREMENTS FOR PLATE HEAT EXCHANGERS FOR MARINE USE

UDC 66·045·1 : 628·12

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 3

March 1985

Indian Standard

GENERAL REQUIREMENTS FOR PLATE HEAT EXCHANGERS FOR MARINE USE

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Indian Standard

GENERAL REQUIREMENTS FOR PLATE HEAT EXCHANGERS FOR MARINE USE

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 31 October 1984, after the draft finalized by the Marine Engineering Sectional Committee had been approved by the Marine, Cargo Movement and Packaging Division Council.

0.2 Plate heat exchangers are widely used on board ships for heating/cooling and heat recovery duties from one fluid to another fluid. They are best suited for the following applications:

a) Main and auxiliary engine jacket water cooling with sea water;

b) Piston water cooling with sea water;

c) Lub oil cooling with sea water;

d) Nozzle cooling with sea water;

e) Fuel valve cooling with sea water;

f) Preheating of jacket water with steam;

g) Domestic water heating with steam;

h) Oil heating prior to centrifuging with steam;

j) Heat recovery, for example, from hot lub oil;

k) Central cooling system;

m) Evaporator and condenser in fresh water distillers; and

n) As dump condenser for condensing steam with sea water.

0.3 Plate heat exchangers with their inherent advantages offer the best possible solution compared to Shell and Tube heat exchangers. It is possible to obtain heat transfer coefficient as high as 3 000-5 000 kcal/h m^2°C for water to water duties. Further, plate type heat exchangers are very compact and will occupy minimum space. They are light in weight and easy to open and clean. Plate heat exchangers are also highly flexible. The heat duties can be increased, decreased or altered by adding/removing and rearranging the plate pack.

1. SCOPE

1.1 This standard covers the general requirements for the design, construction and testing of plate type heat exchangers for use on board ships.

2. GENERAL REQUIREMENTS

2.1 Each plate heat exchanger unit is individually assembled to meet specific capacity, temperature and pressure drop requirements. If operating conditions change, the plate heat exchangers can easily be modified to match just by adding, subtracting or rearranging standard channel plates in the existing frame.

2.2 The plate heat exchangers shall be designed in such a way that full countercurrent and turbulent flow is ensured which shall, in turn, result in a lower heat transfer surface.

2.3 The plate exchanger shall be constructed in such a way that it shall be possible to do maintenance/servicing from a very limited space available on the sides, within the length of its frame. It shall be possible to expose both sides of the entire heat transfer surface for visual inspection and cleaning. A plate that is damaged or needs regasketing shall be easily removable and replaceable by a spare plate in a matter of minutes. In the absence of spares, a temporary repair shall be possible by simply taking out the damaged plate and the matching one next to it and correctly recompressing the pack.

2.4 The inlet and outlet connections for the fluids should preferably be located on the fixed end of the plate heat exchangers (that is, frame plate), so that there is no necessity for removing the pipe connections while opening the heat exchanger for cleaning/servicing, etc.

3. CONSTRUCTIONAL FEATURES

3.1 The plate pack in which heat exchange takes place is clamped between the fixed frame plate and the movable pressure plate by lateral bolts, which shall provide uniform compression to keep the system without leakage.

3.2 The plate pack and pressure plate shall be supported and located by the carrier and guide bars, which should provide a steering and locking system and should prevent any misalignment.

When the bolts are loosened, it shall be possible to slide the plates along the bars one by one for inspection, cleaning, etc, and also to remove the plates out of their slots.

3.3 The heat transfer plates shall be pressed from thin sheet material into a corrugated pattern preferably of the 'herring bone' pattern in such a way that maximum heat transfer is obtained while the pressure drop is kept low. The pressing shall also provide seating grooves into which the gaskets are fixed. The port holes on the plates shall have a double gasket as protection against inter leakage, and also to vent the liquid to the atmosphere in case of failure of one of the gaskets in the port hole.

4. MATERIALS

4.0 The materials of construction of the various parts of the plate heat exchanger shall be as follows:

4.1 Heat Transfer Plates — Titanium, in case sea water is to be used for cooling in the heat exchanger and stainless steel conforming to IS : 6911-1972* if fresh water is used for cooling as in the case of primary cooling in Central cooling systems.

4.2 Gaskets — Nitrile rubber for temperatures up to 110°C. For higher temperature other gasket materials, like resin cured butyl rubber or compressed asbestos fibre shall be used. The limiting temperatures shall be according to the standard design of the manufacturers.

4.3 Frame and Pressure Plate — Carbon steel of tested quality conforming to IS : 226-1975† or IS : 2062-1980‡ or equivalent or carbon steel of pressure vessel quality/equivalent depending upon the agreements between the manufacturer, buyer and the inspection agencies. The thickness of the frame and pressure plate should be in line with the pressure requirements.

4.4 Carrying Bars — The parts of the carrying bar where the plates come into contact/slide should preferably be of stainless steel. If a non-ferrous material like aluminium is used as the carrying bar, the sliding portion should be cladded/covered with stainless steel.

4.5 Tightening Bolts/Studs — These parts shall be of alloy steel duly heat treated with mechanical properties in line with the pressure requirements.

4.6 Tightening Nuts — Tightening nuts shall be of carbon steel with mechanical properties in line with the pressure requirements.

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*Specification for stainless steel plate sheet and strip.

†Specification for structural steel (standard quality) (*fifth revision*).

‡Specification for structural steel (fusion welding quality) (*second revision*).

4.7 Connections — The connection material shall be compatible from corrosion point of view. If there is a weld in the connection, there can be possibility of cracks due to vibrations and stresses. Considering all the above facts, it is suggested that stainless steel or rubber lined connections should be used. Rubber spool connections should not only act as sealing joints but also should be easily removable and replaceable with a new one, if required. The welding is also eliminated by use of rubber spools.

4.7.1 External connections shall be provided with facilities for other accessories and mounting.

5. DESIGN CONSIDERATIONS

5.1 The maximum working pressure for the heat exchanger should be around 12 kgf/cm^2. The normal working pressure is in the region of 6 kg/cm^2. However, manufacturer's recommendation should be sought with regard to the same since different plate patterns will have different working pressures, depending upon the material of construction.

5.2 Pressure Drops — The port holes provided in the heat exchanger shall be of sufficient size, so that the pressure loss in the nozzle of the heat exchanger should be minimum and the pressure drops permitted for the design should be utilized for heat transfer.

5.3 Fouling Margins — The fouling margins should not be too big as to cause lower velocities in the heat transfer channels, which will result in increased fouling tendencies. The manufacturer's recommendation should be sought in this regard to arrive at the optimum fouling margins.

6. INSPECTION

6.1 The purchaser or their authorized agencies shall be offered all reasonable facilities to inspect at any reasonable time, the progress of manufacture of the components.

7. TESTING

7.1 Each completed heat exchanger shall be hydraulically tested at the manufacturer's works/at shipyards/on board vessels, depending upon where the complete assembly of the heat exchanger takes place. The test pressures shall be as agreed to between the manufacturer, purchaser or his authorized agent.

7.2 Test Facilities — If the heat exchanger is assembled at the manufacturer's works, he shall supply, free of charge, the labour and

appliances for hydraulic testing of the complete heat exchangers. If the assembly is done at yard/on board vessel, the yard/ship owner should provide the facilities for assembly and hydraulic testing.

7.3 For the hydraulic test, fresh water may be used.

7.4 The test pressure shall be equal to 1·5 times the design pressure. The test pressure shall be maintained for the period of not less than 30 minutes.

7.5 Before applying pressure the equipment shall be inspected to see that it is tightened to the correct plate pack length.

7.6 Test Procedure — One side of the heat exchanger shall be tested at the test pressure, while the other side is open to atmosphere. Subsequently, the other side is also tested hydraulically keeping the first side open. After this, both sides should be connected and the heat exchanger should be tested in the balanced condition at the required test pressure.

8. MARKING

8.1 The manufacturer shall provide a name-plate of a suitable corrosion resistant material, securely attached to the heat exchanger in a position that is accessible. The name-plate will be stamped with the following information:

a) Manufacturer's name,

b) Type and model No. of the heat exchanger,

c) Manufacturing serial No. of the heat exchanger,

d) Assembly drawing No. of the heat exchanger,

e) Design pressure.....bar,

f) Test pressure.....bar,

g) Design temperature.....°C,

h) Area of heat transfer per plate, and

j) Flow rate of both media.

9. PREPARATION FOR DESPATCH

9.1 Draining — The water used for hydraulic testing shall be drained from the units before despatch.

9.2 Cleaning and Drying — The plates shall be cleaned of any external matter and dried.

9.3 Painting — All external parts of the frame other than stainless steel parts shall be painted with a corrosion-resistant paint. The type of paint, shade, etc, shall be agreed to between the manufacturer and the purchaser.

10. CERTIFICATE OF COMPLIANCE

10.1 Hydraulic Pressure Test Certificate — The manufacturer shall furnish to the purchaser a certificate stating that the heat exchanger has been tested hydraulically at the specified test pressure.

10.2 Material Test Certificate — The manufacturer shall also furnish to the purchaser test certificate for the pressure components in the heat exchanger and any other specified certificate, if agreed to between the manufacturer and the purchaser.

(*Continued from page* 2)

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INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	Unit	Symbol	Definition
Force	newton	N	$1\ N = 1\ kg.m/s^2$
Energy	joule	J	$1\ J = 1\ N.m$
Power	watt	W	$1\ W = 1\ J/s$
Flux	weber	Wb	$1\ Wb = 1\ V.s$
Flux density	tesla	T	$1\ T = 1\ Wb/m^2$
Frequency	hertz	Hz	$1\ Hz = 1\ c/s\ (s^{-1})$
Electric conductance	siemens	S	$1\ S = 1\ A/V$
Electromotive force	volt	V	$1\ V = 1\ W/A$
Pressure, stress	pascal	Pa	$1\ Pa = 1\ N/m^2$